**GEOLOGIC MAPPING OF THE HELEN PLANITIA QUADRANGLE (V52), VENUS: THE FIRST RESULTS.** I. Lopez[1] and V. L. Hansen[2], [1]ESCET-Universidad Rey Juan Carlos, C/Tulipán s/n, 28933 Mostoles, Madrid, Spain (i.lopez@escet.urjc.es), [2]Department of Geological Sciences. University of Minnesota Duluth, Duluth, MN 55812.

**Introduction:** The Helen Planitia Quadrangle (V52) is located in the southern hemisphere of Venus between 25º-50ºS and 240º-270ºE, covering an approximate surface of □7.000.000 km$^2$ between the mesolands of Eastern Parga Chasmata and the lowlands of Helen Planitia. The mean altitude of V52 is between 0 and 2 km over the mean planetary radius (6051.84 km), although some areas of Helen Planitia are below this mean planetary radius. V52 includes a variety of coronae, large volcanoes, ridge belts, and other volcanic and structural features distributed among regional plains materials, allowing the study of their age relationships and evolutionary sequence.

V52 provides the opportunity to investigate: a) the style of tectonism and volcanism in an area of transition between mesolands and lowlands; b) the geologic evolution and the role played in the regional resurfacing model of large tectovolcanic structures (volcanoes, coronae, and large radial fracture systems); C) the relationship of these large structures with other styles of volcanism (e.g. small shields) and tectonism along the quadrangle.

**Data set and mapping techniques used in this work:** Geologic Mapping is at the base of descriptive analysis in geology. A map provides in one glance the distribution of materials and the secondary structures that affect them, the type and characteristics of these materials and structures and their relative age. This work follow the mapping philosophy outlined by [1].

The mapping has been made using two different data sets: a) left and right-looking normal and inverted SAR images in Mercator projection (225 m/pixel); b) Lambert Conformal Conic projected data set that include left-looking radar image and inverted SAR (250m/pixel) and synthetic stereo (450m/pixel) images. With these two data sets a study of the whole area has been carry out with the main goal of determining the primary and secondary structures present at this map scale and to make a first attempt to determine the mayor units for further mapping.

**Structures:** *Fractures.* Fracturing occurs all along the study area. We can discriminate between local fracture trends, formed in relationship with large tectovolcanic features (e.g. radial dyke swarms and coronae) and large fracture trends of regional significance (e.g. chasmata).

<u>Principal regional fracture sets (from older to younger):</u> 1) NW-SE striking fractures. Closely-regularly-spaced fractures that dominate over graben.This fracture set is restricted to the northwestern part of the quadrangle and is locally reoriented to E-W direction by the effect of local stress fields formed in relation to large tectovolcanic features, coronae and large volcanoes (e.g. Chuginadak Mons). In this part of the quadrangle can also be observed how this fracture set predated the N-S fracture that dominates in the southern part of V52. 2) N-striking fractures. Fractures with this direction are present in the whole V52 although is the main direction of the southern half of the quadrangle. Is composed mainly of fractures but graben with this direction are also present. This fracture set form areas of concentrated deformation as Ajina Fossae, where the interfracture spacing gets closer. 3) WNW-ESE (Parga Chasmata). With this direction we observe single lineaments and also paired straight lineaments, interpreted as graben. These lineaments connect the coronae associated with Parga Chasmata and in many cases merge with the annular fractures that form the corona. Some scarps are also recognizable. This direction dominates the northern part of V52, and represents the area with the highest strain of the whole quadrangle.

Similar fracture directions have been described in different studies of areas surrounding V52 (i.e. BAT region of Venus) with the N-striking fractures also predating the NW-SE direction [2]. A change in the orientation of the stress fields in the Beta-Atla-Themis region of Venus has been proposed by [2] to explain this change.

<u>Local fracture sets</u>: The large number of tectovolcanic features found in the study area produced local sets of fractures and locally modify the direction of regional fracture sets around these structures. This large number is also accompanied by a large diversity in tectonic and volcanic style. These tectovolcanic structures include: coronae, novae, paterae and radial fractures systems, interpreted by some authors as the surface manifestation of radial dyke swarms in depth [3].

*Wrinkle ridges.* Different trends of wrinkle ridges can be found in V52. Wrinkle ridges with a N-S direction dominate in the western and central part of the quadrangle and are also present in the southeastern. The other main direction is a NW-SE direction that dominates in the southwestern part of V52. This trend is also present in the northern part but more localized. This NW-SE trend of wrinkle ridges parallel Tsovinar Dorsa, the largest compressional deformation belt present in the area. In the northeastern part of the quadrangle a NE-SW direction can also be observed. Other direction can be observed around large tectovolcanic features (e.g. Oanuava Corona) but do not seem to have regional significance. Temporal relationships between these different trends have not yet been established.

**Materials:** *Basement*. a) Tessera. As in other quadrangles, tessera is the oldest unit where time relations with other materials can be observed. There are different types of tessera terrain outcropping in V52, although the characteristics of the outcrops (i.e. isolated tessera inliers surrounded by younger volcanic materials) make time relations between the different types of terrain difficult to establish. We observe: 1) ribbon-bearing tessera, 2) graben-dominated tessera inliers. b) Highly fractured terrain. Small outcrops of highly fractured terrain appear along the southern half of V52. This type of terrain presents a closely spaced NW fracture trend. The strain in these outcrops is so pervasive that makes impossible to determine the previous characteristics of the material. It appears geographically related to other basement materials (i.e. tessera terrain) in large outcrops that follow a NW trend along the southern part of the quadrangle (e.g Sopdet Tesserae) but also appear as isolated small kipukas surrounded by younger volcanic materials.

*Post-basement volcanic materials.* In relationship with Parga Chasmata we can found a great number of coronae and novae that are the focus of numerous volcanic materials that cover the north part of V52.

A large igneous flow covers great part of the northern V52. It seems to have its origin in an unnamed corona formed in Parga Chasmata. This large flow can be classified as transitional flow field according to the classification for this type of flows established by [4]. Due to its large extent this flow is a useful tool for the determination of the relative timing between some large structures and materials in this part of V52. This large flow postdates coronae and some large volcanic edifices filling the interior lows of the coronae, and covering the outer slopes of the volcanoes. The flow present several flow units, well-defined internal structure, lobate flow structure and irregular boundaries. It also presents some primary structures that give important information regarding its flow direction (i.e. ropy structure) and emission style (i.e channels). The limits of this unit with other are confuse on its E and SW sectors. This large *fluctus* predates the flows originated in Lalohonua Corona and in an unnamed volcanic structure located next to this corona.

The central part of V52 hosts a large number of tectovolcanic features (coronae, large volcanoes and radial dyke swarms), but also other volcanic features as shield fields. The high differences in surface radar properties existing in the volcanic materials that cover the central part of V52, and the cited high number of volcanic edifices could indicate that different materials and flows are present, resurfacing this part of the quadrangle. Nevertheless, the mapping of these units is still on progress and the origin of much of these materials is still to be traced.

The central and southern parts of V52 present a high number of small shields that partially cover large areas, either postdating either predating different secondary structures and materials (tesserae, previous volcanic materials, etc). These shields are found in relation with other large tectovolcanic structures (coronae and radial dyke swarms) but also unrelated to other large features. The role that this shield material could play in the resurfacing of the large plains of Venus have been described and discussed [5].

Sopdet Tesserae and Tsovinar Dorsa separate Helen Planitia from this central part of the quadrangle. Both, the tesseae outcrop and the deformation belt follow a NW-SE trend that mark the limit between these two areas that present differences in number and style of the volcanic features present. This part of V52 does not host large tectovolcanic features as coronae, volcanoes, etc. Nevertheless, large areas that present a high concentration of small shields have been observed. In this southern area a large channel, Sinnan Vallis (49ºS/240ºE) is observed. This channel is 450 km long and runs with an E-W direction eroding the volcanic plains but also a tessera outcrop. Its width is constant along the whole channel even when it runs from one material to another. The origin of this channel is not clear as its both extremes are covered and no volcanic center can be observed.

*Impact structures*. V52 present 11 craters, some of them with bright halos (e.g. Adaiah) and outflow materials (e.g. Wollestonecraft). They are distributed in the entire quadrangle although most of them are in the central part of it. V52 also present two dark splotches in the southern part of the quadrangle.

In *summary* the initial mapping of V52 shows that deformation occurs along the area with wrinkle ridges and fractures present in the different materials. This mapping also show that the large tectovolcanic features present in V52 may have played an important role in the resurfacing of this area. Large flows that have their origin in coronae located in Parga Chasmata cover the north of V52, but the center and southern areas of V52 seem to present more restricted flows found in relationship with coronae and large volcanic features. Large areas hosting a high number of small shields are found around V52 and seem to be another important source for the resufacing of the Helen Planitia Quadrangle.

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